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Sandia National Laboratories Waste Isolation Pilot Plant

An Analysis Plan for Annually Deriving Compliance Monitoring Parameters and their Assessment Against Performance Expectations to Meet the Requirements of 40 CFR 194.42

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1 Introduction and Objectives

This analysis plan details the processes used to meet the regulatory requirement to monitor Waste Isolation Pilot Plant (WIPP) performance against WIPP Performance Assessment (PA) expectations. Compliance monitoring parameters (COMPs) derivations and assessments by Sandia National Laboratories (SNL) are explained. COMP assessments are a part of a comprehensive monitoring program based on Environmental Protection Agency (EPA) regulatory requirements found at 40 CFR § 194.42. The U.S. Department of Energy (DOE) is responsible for the monitoring program and the Management and Operating Contractor (M&O) performs monitoring and data collection functions. The objectives of the monitoring program are to meet the intent of the regulatory requirements and to ensure the WIPP will perform as predicted in the PA. Compliance monitoring is a continuing compliance activity requiring Programmatic Decisions per Nuclear Waste Management Program (NWMP) procedure NP 9-1. These Programmatic Decisions require formalized plans and records documenting assessment results and recommendations.

1.1 Background

The general radioactive waste disposal regulations at 40 CFR Part 191 (EPA 1993) and the implementing WIPP-specific criteria at 40 CFR Part 194 (EPA 1996) require assurance measures. The assurance requirements are designed to provide additional confidence in the long-term compliance of the WIPP with the containment requirements of the EPA. In the WIPP Compliance Certification Application (CCA; DOE 1996), the DOE made commitments to conduct a number of monitoring activities to comply with the criteria at 40 CFR § 194.42 and to ensure that important deviations from the expected long-term performance of the repository are identified at the earliest possible time. These DOE commitments are represented by ten Compliance Monitoring Parameters (COMPs), which are listed in Section 2.4 and Appendix MON of the CCA.

The COMPs are an integral part of the overall WIPP monitoring strategy. The larger overall monitoring program includes several individual monitoring activities, each of which may have one or more drivers, such as State regulations, formal agreements, federal regulations, and health and safety considerations. The DOE's Monitoring Implementation Plan (MIP; DOE 1999a) describes how information and data are extracted from the various WIPP monitoring programs in order to derive the COMPs.

Collection and reporting data derived from the WIPP monitoring programs are the responsibility of the Management and Operating Contractor (M&O). The Scientific Advisor (SA - SNL) uses these monitoring data and observations to derive "values" for the ten COMPs and to evaluate them against performance expectations of the disposal system. The performance expectations are based on results from the WIPP PA, and its associated features, events and processes (FEP) screening arguments, scenarios, models, and parameter values, that form part of the DOE's Compliance Baseline. The results of the SA's evaluation are reported to the DOE via the Office of Regulatory Compliance

(ORC). The COMPs assessments can potentially yield results that indicate a reportable condition under EPA regulations. The DOE's subsequent course of action is determined by the nature of the ORC evaluation:

1. *The COMP data indicate an unplanned and significant change from expected performance.* In this case, the DOE will notify the EPA within 24 hours or 10 days, depending on whether the change indicates a possible exceedance of the containment requirements.
2. *The COMP data do not indicate a significant change from performance expectations.* In this case, the monitoring results and evaluations will be reported to the EPA as part of the DOE's annual reporting commitment and 5-year recertification process. These COMP data may also be used to support a proposed modification of the Compliance Baseline.

The DOE's recertification program and reporting commitments are described in the Recertification Management Plan (RMP; DOE 1999b) and the Reporting Implementation Plan (RIP; DOE 1999c), respectively. The RMP discusses in more detail the various courses of action that will be taken on the basis of the SA's evaluation of monitoring data and on the basis of planning changes. The purpose of this analysis plan is to define the role of the SA in the Compliance Monitoring Program and, in particular, the general strategy for how the SA will derive COMPs and employ Trigger Values to facilitate the rapid screening of monitoring data. A Trigger Value is a measure or limiting value for a particular set of COMP-related monitoring data, that when exceeded, indicates the data **may** represent a significant change in the Compliance Baseline and merit further evaluation/analysis. It should be noted that Trigger Values do not by themselves, indicate an out of compliance or a release limit condition. The process the SA uses in planning modifications to the WIPP monitoring program and assessing impacts of potential changes to the monitoring program is also defined.

2 Approach

Figure 4.2 of the MIP shows the process for evaluation of COMP-related monitoring data and observations. Figure 2.1 of this plan is an expansion of the MIP figure and describes activities designed to assess, use, and plan reactions to the monitoring data released through the M&O Monitoring Program Administrator. The M&O Monitoring Program Administrator is responsible for transferring data to SA and is the communication point or the M&O.

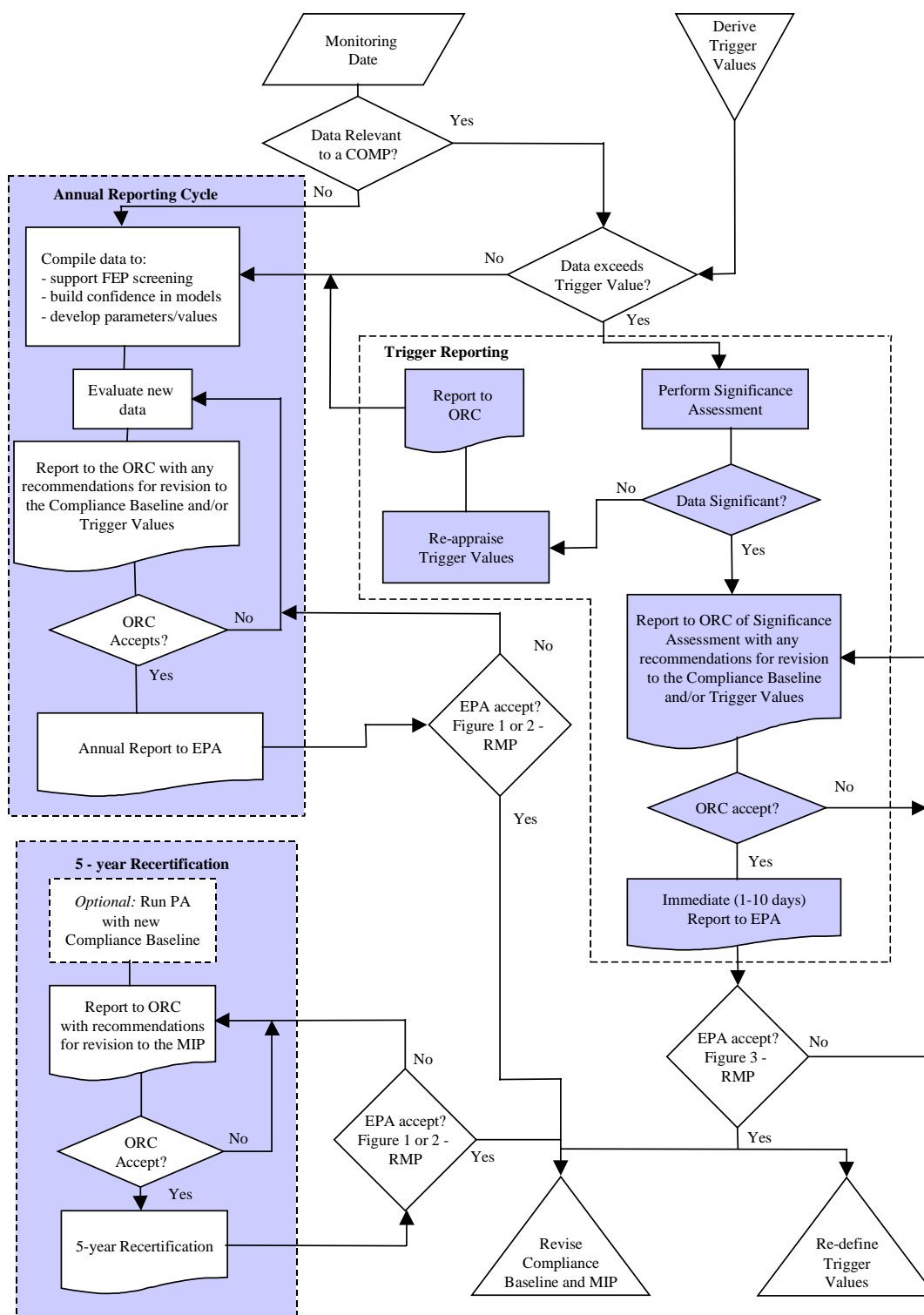


Figure 2.1: Activities Evaluating and Reporting Compliance Monitoring Parameters

2.1 Trigger Value Definition and Use

The intent of the compliance monitoring program is to recognize anomalous conditions and report specific performance conditions to the EPA as required by 40 CFR 194.4. The DOE is ultimately responsible for reporting these performance conditions to the EPA.

All relevant compliance monitoring data are reported to the EPA on an annual basis by the M&O. However, the M&O Monitoring Program Administrator also has a responsibility to notify the ORC of anomalous data immediately, outside of the annual process. The definition of Trigger Values (TVs) by the SA facilitate such reporting. Through interaction with the SA, the M&O will be aware of the TVs and will readily be able to identify anomalous and potentially significant monitoring data. On notification of anomalous monitoring data by the M&O or the SA, the ORC will instigate the Trigger Reporting Procedure and may direct the SA to further evaluate and characterize the significance of the data. For those monitoring elements that do not have TVs, the SA performs periodic assessments designed to recognize anomalous conditions, which would then be reported to the ORC. The ORC reviews the information provided by the SA and M&O and will determine if the EPA must be notified per the regulations.

The TVs include a combination of limiting values, ranges, and observations that can be compared to the data and information, provided by compliance monitoring activities (Section 2.4 of this analysis plan details the derivation and documentation of the TVs). However, if monitoring data lie outside the TVs, this **does not** in and of itself indicate significant change to the Compliance Baseline. The first stage of the Trigger Reporting Procedure is a “Significance Assessment,” whereby the SA, when directed by the ORC, evaluates the potential impact of the new data, firstly on the various elements of the WIPP PA, and subsequently on the expected performance of the disposal system.

There are two scales of significance, as set out by the EPA at 40 CFR § 194.4(b). The first scale is defined by the criteria at 40 CFR § 194.4(b)(3)(ii) as a change that will cause:

- The containment requirements established pursuant to 40 CFR § 191.13 to be, expected to be, exceeded.
- Releases from already-emplaced waste to lead to committed effective doses that are or are expected to be in excess of those established pursuant to 40 CFR § 191.15 (not including emissions from operations covered pursuant to Subpart A of 40 CFR Part 191).
- Releases that lead to or are expected to lead to concentrations of radionuclides or estimated doses due to radionuclides in underground sources of drinking water in the accessible environment to exceed the limits established pursuant to Subpart C of 40 CFR Part 191.

In terms of compliance monitoring, if it is determined that monitoring data indicate that any of the above criteria will be met, then the DOE must cease waste emplacement immediately and notify the EPA within 24 hours of the determination.

The second scale of significance is defined by the EPA at 40 CFR § 194.4(b)(3)(v), where it is stated that if a condition is discovered that “differs significantly” from what is indicated in the most recent compliance application, but that does not meet the criteria of 40 CFR § 194.4(b)(3)(ii), then the DOE must report the change within ten days of its discovery. Anomalous monitoring data may represent (after confirmatory analysis) an *unplanned* significant change. The DOE’s reporting processes for an unplanned significant change are described in detail in the RMP and is shown graphically in Figure 3 of the RMP.

The Significance Assessment conducted by the SA is based on previous performance assessment analysis experience. Having conducted a number of previous PA calculations and sensitivity analyses, the SA has a qualitative and quantitative awareness of how changes in particular PA elements can affect predictions of long-term performance. The SA will derive the TVs (Section 2.4) by taking into consideration such things as how the monitoring data support or develop PA parameter values, relate to screening of FEPs, build confidence in PA models or influence other activities. Then, if it is clear that newly collected monitoring data do not represent a change that meets the definitions of significance given above, the SA will report a summary of its evaluation to the ORC. The SA may also recommend revision of the TVs or monitoring program in light of the new data (see Section 2.4).

2.2 Annual Reporting Cycle

Outside of the reporting requirements discussed above, COMPs are assessed and reported to the DOE annually. SNL’s role in the reporting cycle is to use the monitoring data to derive the COMPs, to assess them against PA expectations, to use the results and new information, and to make recommendations for modification to the Compliance Baseline, to M&O monitoring programs, and to TVs as appropriate. As with the Trigger Reporting Procedure, recommendations for changes made by SNL are subject to review and approval by the ORC and the EPA, as set out in the procedures for planned insignificant and significant changes in Figures 1 and 2 of the RMP.

2.3 5-year Recertification Cycle

The 5-year Recertification Cycle will offer another opportunity for the SA to make recommendations for insignificant changes to the Compliance Baseline. As part of the recertification application, a PA may be performed at the discretion of the DOE and/or at the direction of the EPA, on the basis of the degree of change in the Compliance Baseline since the previous compliance application. On the basis of the revised Compliance Baseline, the SA may also make recommendations for changes to the COMPs and the related parts of the DOE MIP. It should be noted, however, that changes to the MIP can

be proposed at any time, via the ORC, through the monitoring program revision process (Section 2.5).

2.4 Trigger Values Derivation and Revision

TVs shall be derived for each of the following COMPs.

1. Drilling Rate
2. Probability of Encountering a Brine Reservoir
3. Waste Activity
4. Subsidence
5. Changes in Groundwater Flow
6. Change in Groundwater Composition
7. Creep Closure
8. Extent of Deformation
9. Initiation of Brittle Deformation
10. Displacement of Deformation Features

The process for deriving TVs is shown in Figure 2.2. This section describes the general process and documentation requirements. The COMP titled “drilling rate”, is used as an example for deriving a TV¹. Appendix A of this analysis plan contains an example of a TV record which details the specific information that shall be used to document the results of the TV derivation in a formal record per NWMP QA procedure NP-9-1, *Analyses*. Each COMP TVs shall use the format (as illustrated in the Pro-Forma Table in Appendix A) to document the TV derivation. Note that in most cases, the TVs relate to the monitoring data used to derive the COMPs, and not directly to a performance parameter. With regard to TVs, the COMPs simply represent relationships between the monitoring data and the PA, and help to formalize reporting commitments. Because the derivation of TV is based on project experience and often does not involve quantitative analysis, a TV can only indicate a *potentially* significant condition or event. A more quantitative and issue-specific Significance Assessment, which forms part of the Trigger Reporting Procedure, is required to determine the actual significance of the condition or event. This distinction provides necessary flexibility in setting the TV to identify noteworthy changes and to ascertain the significance of the observation.

Step 1 in deriving TVs is to define the process to derive the ten COMPs. The derivation information is contained in the CCA Appendix MONPAR and Chapter 7. The data used to generate the COMPs are provided by the M&O Compliance Monitoring Administrator.

Some COMPs, such as “drilling rate”, will be reported as a single value, which can be evaluated against a benchmark value directly, while others such as “initiation of brittle deformation”, may be reported as a set of observations and/or measurements which can only be related to PA indirectly by validating or invalidating a conceptual model or

¹ The example is used for clarity, the actual “drilling rate” COMP trigger value must be derived and documented per this AP.

parameter within the model. In each case, the monitoring data used to derive the COMP will need to be identified and the characteristics of the data, as reported in the M&O annual report(s), defined. The following information shall be listed in the assessment report.

Any data manipulation or interpretations required to generate the COMP will be specified, and these processes shall be appropriately documented and validated. For example, the drilling rate used in the WIPP PA was derived from the number of deep (i.e., > 2,150 feet) hydrocarbon, potash, sulfur, and other deep boreholes drilled in the Delaware Basin over the last 100 years (CCA, Appendix DEL, Section 7). Through the DOE's Delaware Basin Monitoring Program (DBMP), monitoring data will be collected on boreholes drilled in the Delaware Basin each year. The reporting of these data will need to be examined by the SA to determine how to derive the number of new deep boreholes drilled. This number can then be used to derive COMP "drilling rate," defined as deep boreholes drilled per 10,000 years per square kilometer, from:

$$\left(\frac{(\text{number of boreholes})_{CCA, 100 \text{ years}} + (\text{number of boreholes})_{\text{Year } 1} \dots + (\text{number of boreholes})_{\text{Year } N}}{100 + N} \right) \times \left(\frac{10,000}{23,102.1} \right)$$

where N is the number of years of monitoring data since the CCA, and 23,102.1 is the area in square kilometers of the Delaware Basin.

Step 1 also defines the COMP, list background information related to the COMP, identify what is reported by the M&O for the COMP, and identify how monitoring data are used to derive the COMP. A table (see Appendix A for example) shall be generated with the following information for each COMP.

- COMP
- M&O Program that generates related data
- Related PA Parameters
- FEPs with related Screening Decisions/Text
- Related Modeling Assumption
- Other Information as appropriate

Step 2 is to map the COMPs to the PA elements, such as FEP screening arguments, model assumptions, and/or parameter values that they directly affect or influence. Through Step 1 above, this also provides a mapping between the monitoring data and performance assessment. Mapping between the COMPs and the PA has already been done at a general level in the MIP (Table 3.2) and in Appendix MONPAR of the CCA. As with Step 1, any data manipulation required to generate the PA elements from the COMPs will be specified and the manipulation process appropriately quality-assured. For example, the COMP "drilling rate" is combined with the area of the WIPP repository (0.126 square kilometers) and the area occupied by waste to derive a rate constant for use in the WIPP PA.

Step 3 will use the relationships identified in Steps 1 and 2 to attempt to determine an existing baseline for COMP-related monitoring data on the basis of the information that was used to derive the Compliance Baseline. The Compliance Baseline for the WIPP PA elements is established from the information supplied in the CCA and additional information supplied by the DOE to the EPA Docket.

A review of records such as WIPP Parameter Data Creation, Update, Error Correction and Status Change Forms (SP 9-1-1 to SP 9-1-4 and the former 464 Form) will help in establishing the baseline. Memoranda such as those found in Appendix MASS of the CCA, that document how site characterization data were used to derive/support PA screening, modeling assumptions, and parameterization will help as well. Appendix SRC and PAR can also be used to research COMP baseline information. For example, the “drilling rate” baseline information is found in Appendix DEL of the CCA which documents the number and types of boreholes drilled over the last 100 years in the Delaware Basin. These numbers, divided by 100, provide the baseline for the DBMP monitoring of drilling activity each year, and it will be readily apparent whether the drilling rate is increasing or decreasing with respect to the baseline.

Step 4 will compile a qualitative and/or semi-quantitative indication of the impact that changes in the PA elements identified in Step 2 have on the performance of the disposal system. This assessment uses results from sensitivity analyses performed for the CCA (Appendix MONPAR, Appendix SA, EPA’s Performance Assessment Verification Test [PAVT], Helton et al. 1998) and other appropriate annual sensitivity analyses (ASAs) performed as part of the recertification strategy.

The ultimate performance measures, and the measures whereby significance is measured at 40 CFR § 194.4(b)(3)(ii), are calculated releases, doses and groundwater concentrations. However, the majority of PA elements will have little or no direct bearing on these measures. Therefore, intermediate measures, such as brine inflow and gas pressure, may also be used to indicate influences on sub-system performance. Such measures can be used to evaluate significance according to the EPA’s definition at 40 CFR § 194.42(c) which states that “A disposal system parameter shall be considered significant if it affects the system’s ability to contain waste or the ability to verify predictions about the future performance of the disposal system.” This definition was used by the DOE in Appendix MONPAR of the CCA to determine the list of ten COMPs.

Step 5 will use the baseline values identified in Step 3 and the impact of changes in the PA elements from Step 4 to determine what changes (i.e., what Trigger Values) in the monitoring data used to derive the COMPs could be significant. Changes in data that map to PA elements with only sub-system influences in Step 4 are unlikely to be significant according to the EPA’s discussion in 40 CFR § 194.4(b)(3)(ii) and as ranked in CCA Section 7.2.

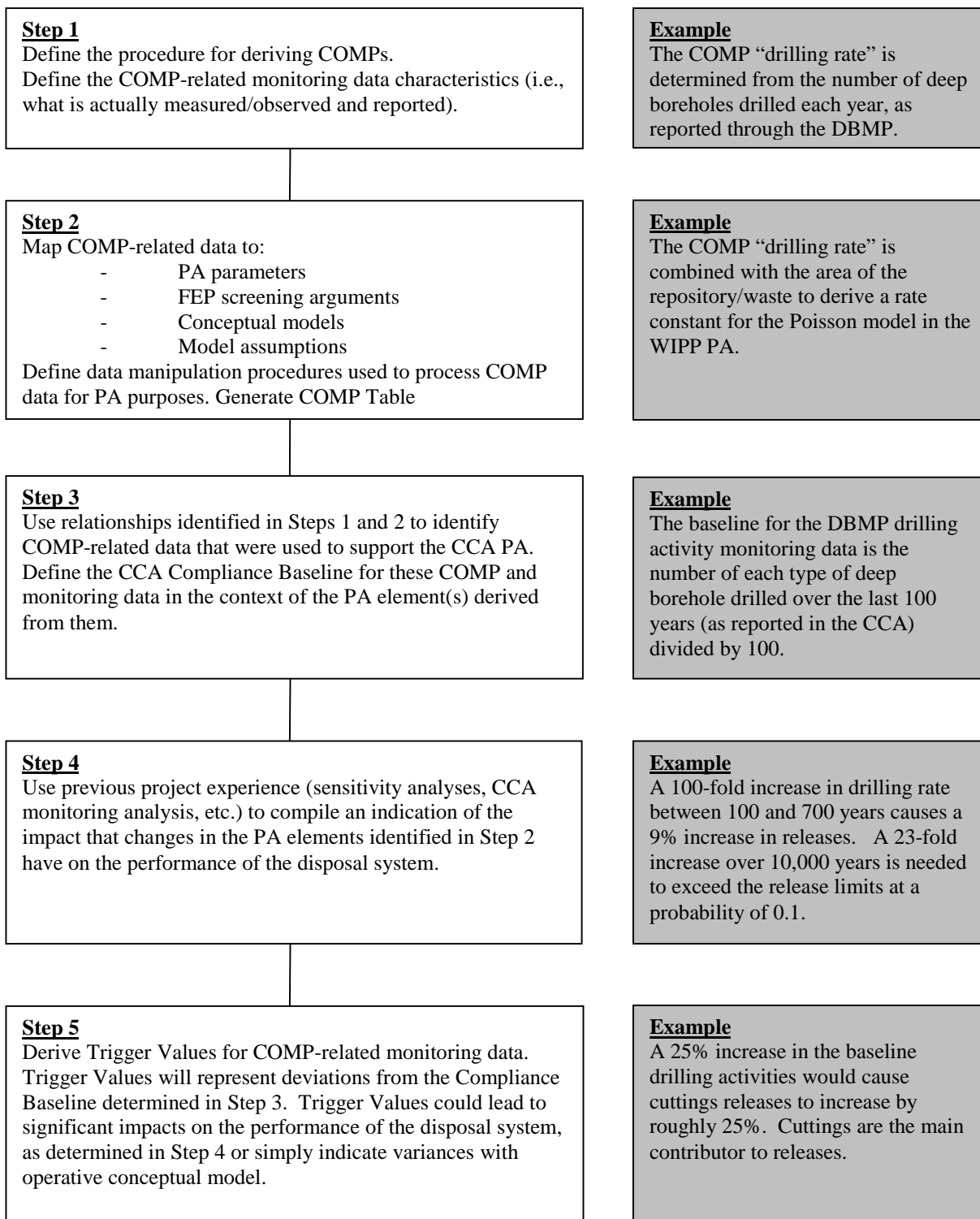


Figure 2.2: The Trigger Value Derivation Procedure.

However, such changes could be significant according to the DOE's definition of significance to comply with the EPA's second order of significance at 40 CFR § 194.4(b)(3)(v). It is possible that no significance can be attached to changes in the PA elements, in which case the TVs will be assigned a textual value of "none". The derivation and justification of TVs will be documented and appropriately quality-assured under NWMP QA procedure NP 9-1. For the example of the COMP drilling rate, a 25% increase in drilling rate could be impactful and could be taken as the TV. Therefore, the monitored number of deep boreholes drilled per year would have to increase such that the compliance baseline value of 10.8 deep boreholes increased to 13 boreholes per year (rounded down to the nearest integer and averaged over $100 + N$ years of monitoring). Again this is only an example, the true drilling rate TV must be derived and documented per this plan.

The procedure for revision of TVs will be largely based on revision to the information and evaluation in Steps 4 and 5 above. However, changes to the data manipulation processes in Steps 1 and 2 may require the associated Trigger Values to be entirely re-derived. Modifications to the TVs and monitoring programs can be recommended to the ORC by the SA at any time. Changes to the monitoring program and the COMPs may require EPA approval prior to implementation per the requirements of 40 CFR § 194.4, however TVs do not apply since they were not part of the original certification basis. TVs are only a tool to aid in identifying conditions that could lead to a reportable change from expected conditions.

2.5 Monitoring Program Revision Process

On request at any time from the EPA, DOE may be required to evaluate the impact on the ability of the Compliance Monitoring Program to monitor the current COMPs and to detect significant deviation from expected performance. Examples of such changes include the introduction of new measurement technologies and techniques, new regulatory requirements, addition/removal of a monitoring parameter, or amendment of measurement intervals. As the monitoring program progresses through the operational period at WIPP, SNL may also recommend changes to the monitoring program. Examples include changing the monitoring process to develop new data, changes to the data collection frequency to increase data population for a dynamic system, or increasing the period between sampling events for more static systems.

Analysis of the effect of a change to existing monitoring practice will require the SA to check whether any monitoring data that will be affected by the change are used in the derivation of COMPs. This will be relatively straightforward to evaluate, since such monitoring data will have an associated TV. If data are affected, the SA will need to evaluate the consequent effect on the compliance monitoring program. Trigger Values may need to be reevaluated if the monitoring data characteristics will be affected by the change.

For changes that propose to measure new monitoring data-types and/or related COMPs, the SA may evaluate the benefit of the proposed new data using criteria similar to those used in the CCA (Appendix MON and Attachment MONPAR) to derive the current list of ten COMPs. The new data should either help in the reporting of the existing COMPs, or relate to PA elements that:

- (a) can either be used to detect deviation from expected performance, or can be used to build confidence in a particular aspect of the modified system, and
- (b) can be analyzed meaningfully from data collected over the operational period.

If such PA elements are identified, then the proposed changes may be valid and a new COMP may need to be defined. If the proposed changes are accepted, the SA will need to establish appropriate TVs.

2.6 Analysis Report and Records

An analysis report shall be used to document the results of all TV derivations, annual COMPs assessment, change assessments and program modification recommendations. Each report shall meet the requirements of NWMP QA procedure NP 9-1 for records.

2.6.1 TV Derivation Report

As discussed in Section 2.4 the TV derivation process uses five basic steps. Step 1 generates the COMP, Step 2 generates a table with the following for each COMP:

- COMP
- M&O Program that generates related data
- Related PA Parameters
- FEPs with related Screening Decisions/Text
- Related Modeling Assumptions
- Other information as appropriate.

Steps 3 to 5 generate the TV and another table which shall follow the format example in Appendix A.

The TV Derivation Report if generated per this plan and shall be modified as necessary. No schedule is implied for generation or revisions.

2.6.2 Annual COMPs Assessment Report

The Annual COMPs Assessment Report shall use the information from the TV Derivation Report or the last annual assessment report and revise the information which generated the COMPs using the latest COMPs data. The report shall document the COMPs assessment using the format of the example in Appendix A and text that describes the results of the assessment. Specifically, the Annual COMPs Assessment Report shall contain the table from Step 2, Appendix A material and text documenting the results of the assessment for each COMP.

The ORC may request further analysis or a significance analysis per Section 2.1. These types of analyses shall be documented as a record per NWMP QA procedure NP 9-1.

The M&O monitoring program administrator shall provide SNL with the data for each year ending September 15. The Analyses report shall be completed by the first week in November of each year (based on the information provided by the M&O) subsequent to the issuance of this AP.

2.6.3 Change Assessments and Program Modification Recommendations

Changes to the monitoring program can be recommended to the ORC at any time. Recommendation may be documented in the Annual Assessment Report or they may be made through a formal memorandum to the DOE ORC.

3 Tasks

The responsibilities and roles of the various organizations involved in the Compliance Monitoring Program have been set out, where appropriate, above. This section presents a summary of these responsibilities:

M&O

- Collect monitoring data, including data required for the COMPs
- Report TV and anomalous results to the ORC immediately
- Report routine monitoring results to the ORC and SA annually
- Activities coordinated by the M&O Monitoring Program Administrator, who:
 - Interacts with the ORC and the SA
 - Compiles deliverables to fulfill the M&O reporting commitments
 - Ensure SA is provided with new monitoring data and is aware of proposed/approved changes to the Compliance Baseline and MIP

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- Define Trigger Values
- Derive COMPs from monitoring data
- Perform Significance Assessments for data that lie outside Trigger Values
- Make recommendations to the ORC of the courses of action for unplanned significant changes
- Make recommendations to the ORC for revision of Trigger Values and the Compliance Baseline
- Requests MIP Revisions and reevaluations
- Make recommendations to the ORC for revision to COMPs and the MIP in response to changes in the Compliance Baseline
- Integrate and interface between different parts of the SA, the SA and the ORC, and the SA and the M&O

- Respond to requests from the ORC
- Compile deliverables to fulfill the SA reporting commitments

DOE's Office of Regulatory Compliance

- Oversee and manage/encourage interaction between the SA and the M&O
- Review and approve or disapprove recommendation from the SA
- Manage reporting commitments to the EPA
- Act as the point of contact between the DOE and the EPA
- Commission data evaluations, significance assessments and impact analyses from the SA

4 Special Considerations

All analyses will be conducted in accordance with applicable quality assurance (QA) procedures, following the Programmatic Decisions (PD) requirements of NWMP QA procedure NP 9-1.

Data used to generate COMPs originate at WID and fall under their QA programs. Since these data are generated under qualified programs meeting EPA quality assurance requirements, no additional qualification of data is required under this analysis plan. Any questionable data shall be communicated back to the M&O. The SA shall work with the M&O to ensure the quality of the data generated from the monitoring programs.

5 Applicable NWMP Procedures

NP 2-1 Qualification and Training
NP 6-1 Document Review Process
NP 9-1 Analyses
NP 17-1 Records

6 References

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EEG (Environmental Evaluation Group). 1998. *Evaluation of the WIPP Project's Compliance with the EPA Radiation Protection Standards for the Disposal of Transuranic Waste*. Report EEG-68, Environmental Evaluation Group, Carlsbad, NM.

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EPA (U.S. Environmental Protection Agency). 1996. *40 CFR Part 194: Criteria for the Certification and Re-Certification of the Waste Isolation Pilot Plant's Compliance With the 40 CFR Part 191 Disposal Regulations; Final Rule*, Federal Register. Vol. 61 no.28, 5224-5245.

EPA (U.S. Environmental Protection Agency). 1998. *Technical Support Document for Section 194.23: Sensitivity Analysis Report*. EPA Air Docket A-93-02, Entry V-B-13.

Helton et al. 1998. *Uncertainty and Sensitivity Analysis Results Obtained in the 1996 Performance Assessment for the Waste Isolation Pilot Plant*. SAND98-0365, Sandia National Laboratories, Albuquerque, NM.

Appendix A – COMP Documentation Example

For each COMP:

Title

Related Monitoring Data

- Monitoring Program
- Data-type ID.
- Data characteristics (e.g., number, observation, units)
- Compliance Baseline value (if any)

COMP Derivation Procedure

Related PA Elements

- Title
- Element type (e.g., FEP, parameter, modeling assumption)
- Relationship/derivation procedure (to COMP and/or related monitoring data)
- Compliance Baseline value
- Significance of change in value (based on experience)

Assigned Monitoring Data Trigger Values

See example Table

EXAMPLE TRIGGER VALUE DOCUMENTATION TABLE

Trigger Value Derivation Pro-Forma				
COMP Title:	Drilling Rate			
COMP Units:	Deep boreholes (i.e., > 2,105 feet)/square kilometer/10,000 years			
Related Monitoring Data				
Monitoring Program	Monitoring Parameter ID	Characteristics (e.g., number, observation)	Compliance Baseline Value	
DBMP	Deep hydrocarbon boreholes drilled (id. = ?)	Integer per year	10,640 per 100 years	
DBMP	Deep sulfur coreholes drilled	Integer per year	89 per 100 years	
DBMP	Deep potash coreholes drilled	Integer per year	19 per 100 years	
DBMP	Deep stratigraphic core tests drilled	Integer per year	56 per 100 years (excluding WIPP test holes)	
DBMP	Other deep boreholes drilled	Integer per year	0	
COMP Derivation Procedure				
(Total number of deep boreholes drilled/number of years of observations) x (10,000/23,102.1) [i.e., over 10,000 years divided by the area of the Delaware Basin in square kilometers]				
Related PA Elements				
Element Title	Type and ID.	Derivation Procedure	Compliance Baseline	Impact of Change
Drilling rate	Parameter LAMBDAD #3494	COMP/10,000 years	4.68E-03 per km ² per year	100-fold increase from 100 to 700 years yields 9% increase in releases (EPA 1998). 23-fold increase over 10,000 years exceeds release limits at 0.1 probability (EEG 1998). Proportional increase in cuttings/cavings releases.
Assigned Monitoring Data Trigger Values				
Monitoring Parameter id.	Trigger Value	Basis		
Deep boreholes drilled (derived from the sum of the five monitoring parameters given above)	13 per year (rounded down to the nearest integer over 100 + N years of monitoring)	Based on conservative assumption of a proportionate increase in cuttings/cavings releases and in total releases.		